Computers in Human Behavior 64 (2016) 183–190

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Full length article

Kidnapping WhatsApp – Rumors during the search and rescue operation of three kidnapped youth

Tomer Simon [a, b, *], Avishay Goldberg [b, c], Dmitry Leykin [a, b], Bruria Adini [a, b]

[a] Department of Emergency Medicine, Recanati School for Community Health Professions, Faculty of Health Sciences, Ben Gurion University of the Negev, Beer Sheba, Israel

[b] PREPARED Center for Emergency Response Research, Ben Gurion University of the Negev, Beer Sheba, Israel

[c] Department of Health Systems Management, Faculty of Health Sciences, Ben Gurion University of the Negev, Beer Sheba, Israel

ARTICLE INFO

Article history:
Received 18 January 2016
Received in revised form
23 June 2016
Accepted 29 June 2016
Available online 6 July 2016

Keywords:
Social media
Terror
Emergency management
Misinformation
Rumor
WhatsApp

ABSTRACT

During terror attacks, information with unknown credibility might circulate and people use rumors to compensate for information gaps. On 06.12.2014, three teenagers were kidnapped from a bus station in the West Bank and found dead after several days. A gag order was issued, causing interest in alternative sources of information. This study investigated how information spread through WhatsApp during the search operation using a participatory research approach. 13 rumors circulating on WhatsApp were collected, nine of which were verified, and found to be true. A web-based survey revealed that 61.1% of 419 respondents received information regarding the kidnapping through WhatsApp; 38.9% through Facebook. Sources of two rumors and participation of emergency authorities in rumor dissemination were identified. Some rumors originated from the family and community of the abductees, while other WhatsApp messages included information and names of two abductees, which were not public at the time. When emergency authorities share unconfirmed information, it is perceived as more credible than information spread by citizens. During the operation, official representatives did not correct or refute any rumors. Locating the source of a rumor is challenging and thus it is important to actively investigate rumors in real-time in order to locate the source.

1. Introduction

People are natural information seekers. During an emergency they search for facts through both official and unofficial sources, utilizing common and familiar channels (e.g. telephone, email or text messages) (Stiegler, Tilley and Parveen 2011; Palen & Liu, 2007) and seek any available venue for information, including newspapers, television, and the Internet (Boyle et al. 2004). However, due to the high availability and accessibility of the social media, people rely primarily on social networks to obtain information (Palen & Liu, 2007). Abbassi et al. (2010) showed that during a crisis, people searched for information related to their specific neighborhood and community, and activated even weak ties in their social networks in order to retrieve it.

During armed conflicts or terror attacks, information with unknown credibility, from official or unofficial source might circulate. According to Lewandowsky et al. (2013), two types of inaccurate information originate from official sources during armed conflict: Misinformation, which is "information presented as truthful initially but turns out to be false" (488); Disinformation that constitutes "outright false information that is disseminated for propagandistic purposes" (488).

Rosnow, Yost & Esposito (1986) stated that the more stressful a situation is perceived to be, the more urgently people will seek to clarify it and in order to alleviate their own anxiety.

Social media are used during emergencies to distribute relevant, critical information to the public and the authorities, and may be simultaneously used to distribute rumors, misinformation and unverified data, which propagate rapidly (Mendoza, Poblete and Castillo 2010; Bird, Ling and Haynes 2012; Hagar, 2013; G 2013, Gupta, Lamba, Kumaraguru, & Joshi, 2013). Heverin and Zach (2012) argued that social media tools such as microblogging can play a vital role in collective sense-making during crises. Where official information is lacking, social media can operate as

* Corresponding author. Emergency Medicine Department, Recanati School of Community Health Professions, Faculty of Health Sciences, Ben-Gurion University of the Negev, POB 653, Beer Sheba, 84105, Israel.
E-mail address: tomersi@asonot.org.il (T. Simon).

http://dx.doi.org/10.1016/j.chb.2016.06.058

backchannels for communication and contribute to the dissemination of false and inaccurate information (Sutton, Palen and Shklovski 2008). During Hurricane Sandy, a storm which devastated parts of North America in 2012, 'hostile' entities distributed rumors and fake photos, which propagated virally through social media and caused panic and chaos (Gupta et al. 2013;; Hagar, 2013). Immediately after the Boston Marathon bombing, a terrorist attack which killed 3 and injured hundreds in 2013, individuals published misinformation on Twitter including accusations and inaccurately identified the bombers (Cassa, Chunara, Mandl, & Brownstein, 2013; Starbird et al. 2014).

People use rumors to compensate for information and knowledge gaps in order to explain the event (Rosnow, Yost and Esposito 1986). This frequently happens during times of uncertainty and fear or in the absence of relevant and available information (Ma, 2008). Dervin's (1983) theory of sense-making assumes that people constantly face cognitive gaps in their worlds and try to fill them by communicating and interacting with others. Formerly, rumors propagated from mouth-to-ear, a process that took considerable time to reach large crowds (Hagar, 2013). As long as the information was not verified, it was considered a rumor. Kwon, Cha, Jung, Chen, and Wang (2013) classified rumors retrospectively into three categories – true, false, and unknown, after official information was published. (Kwon et al. 2013). A rumor can be defined as information or story that is initiated and distributed without confirmation of its credibility or foundation; i.e. without checking whether it is true or false (Ma, 2008). Ahren and Sosyura (2014) argued that a rumor consisting of speculation may be accurate at the time of its publication, but become false at a later stage. Rosnow, Yost & Esposito (1986) stated that people disseminate two types of rumors during times of stress and uncertainty, those containing disturbing information, and those containing comforting or wishful information.

Evidence reveals that people dismiss misinformation if they are suspicious of its source (Lewandowsky et al. 2013). Researchers suggest that the masses act as "collaborative filters of information" (Mendoza, Poblete and Castillo 2010).

Limited research has been conducted on the propagation of rumors through social media during emergencies. Mendoza, Poblete & Castillo reported that individuals tend to question false rumors on Twitter, while tweets providing true information tend to be validated by 95.5% of the readers. Starbird et al. (2014) investigated correction of misinformation via microblogging after the 2013 Boston Marathon Bombing. They explored three rumors (later found to be false) that were spread on Twitter in the aftermath of the incident. Their main finding suggested that "corrections to the misinformation emerge but are muted compared with the propagation of the misinformation" (p. 654).

WhatsApp is a social network messaging application for smartphones that allows users to communicate easily. According to a blog post published in April 2014 by WhatsApp, they have exceeded 500 million users globally, who share more than 700 million photos and 100 million videos daily (WhatsApp, 2014). In 2015 WhatsApp gained 200 million additional users and reached a total of 900 million global subscribers (Koum and Zuckerberg 2015). Users can send texts, images, videos, short voice messages and free calls to other users. WhatsApp users can create groups, each with up to 100 members and numerous administrators.

WhatsApp is a very popular messaging tool in Israel. According to a survey conducted in 2014, 92% of smartphone owners in Israel use WhatsApp, 86% on a daily basis (The Marker 2014). Many families have created a group to communicate and update each other. WhatsApp has also 'infiltrated' the Israeli Defense Forces (IDF) and is widely used to exchange information, updates and general gossip. Following cases where sensitive information was published by IDF personnel on WhatsApp, the Information Security Department banned its use in February 2014 (Dvorin, 2014). Nonetheless, it is difficult to enforce such a ban; thus, soldiers continue to use it. WhatsApp is used frequently by all first responder organizations as a communication platform. These organizations include the Israeli Police, Fire and Rescue Authority, and Emergency Medical Services. At present, these organizations use WhatsApp as a formal communication channel to disseminate notifications and updates to their personnel on local, regional and national levels. Although effective risk communications are a mandatory component of emergency management, security authorities often use a gag order to prevent information leak to the public.

For the purpose of this paper, any information that circulated through social media concerning the event was considered as a rumor, or unverified information, until proven to be true or false. This paper uses a participatory action research approach in order to understand how rumors spread via social media during terror events.

2. Methodology

2.1. The terror incident

On the night of June 12, 2014, three Israeli teenagers were kidnapped from a bus station. A few minutes after the kidnapping, one of the abducted teenagers managed to call the police emergency line and whispered the words "I was kidnapped". The police dispatch operator thought it was a prank call and did not follow required procedures. More than 4 h later, when their families reported their sons as missing, search operations were initiated. During the early morning hours, the IDF applied for and subsequently issued a gag order on the abduction and search operations concerning the three teenagers (Horowitz, Roth and Weiss 2014). On July 1, 2014, the operation concluded with the discovery of the bodies of the three teenagers (IDF Spokesperson, 2015, Lapin, 2014).

Throughout the morning of June 13, there was a buzz in Israel that 'something is happening' or has happened in the security domain. From noon, various people began to receive WhatsApp messages mentioning the kidnapping of two teenagers somewhere in the West Bank. As no information was available to the public, many rumors began to circulate on social media.

This study was conducted to investigate how information, both true and false, spread through WhatsApp during the days of the abduction. The objective was to identify the paths of rumor initiation and propagation through social media and to understand its mechanisms during a highly sensitive security operation.

2.2. Research tools

In order to study the rumor propagation process, we had to establish a way to receive the rumors circulating on WhatsApp. On the morning of June 15, we posted a request on one of our personal Facebook profiles asking people who had received any information on the kidnapping through social media prior to the official announcement of the IDF spokesperson on Friday June 13 at 17:00, to contact us.

The "detective work" done to trace the source of rumors was based on a methodology described by Scanlon (1977). The current research and data collection were conducted during the actual event.

A number of people posted replies on the wall stating that they received information and some sent private messages. We used snowball and chain-referral sampling methods to recruit

respondents. All respondents were contacted and asked the following questions:

- What message did you receive (rumor/misinformation/true information)?
- In which social media platform did you receive it (WhatsApp/Facebook)?
- When did you receive it?
- From whom did you receive it (group/friend/family)?
- Did you distribute the message further?
  - If yes, to whom and when?
    - Whether you distributed it further or not, did you think this message was credible?
- Can you connect us to the person who sent you the message? If not, can you ask your source these questions and relay the response to us?

All answers were recorded on an Excel spreadsheet.

The process was iterative for each source in the chain and continued until a "dead-end" was reached. A dead-end was defined as refusal to disclose additional information by one of the sources, which prevented us from receiving information from or on the next source. The respondents were requested only to provide information concerning the source of the rumors and not to evaluate their credibility. Fig. 1 presents a conceptual model of the research process.

Three methods were used to validate the information within the rumors: 1) information published by formal news channels during or following, the event that verified/invalidated the rumor; 2) contacting the sources mentioned in the rumor; 3) contacting external official sources that were able to provide additional information about the rumor, such as military correspondents who possess knowledge unavailable to the public.

In addition, on Sunday, June 22, a web-based survey was published using Qualtrics Research Suite software (Qualtrics, Provo, Utah) to assess the level of credibility people attribute to information published on WhatsApp and Facebook during emergencies. A link to the survey was published on the author's emergency management Facebook group as well as his personal profile page. It was also distributed via email to approximately 250 employees of the department where the author is employed. The survey included 14 multiple choice questions, focusing on demographic information (3 questions), social media usage (3 questions), rumors related to the event (3 questions), social media credibility, trust and privacy (3 questions), and social media ease and frequency of use (2 questions).

The study was approved by the institutional review board of the Ben Gurion University of the Negev. All participants gave their informed consent to participate in the study.

3. Results

Twelve people responded on June 16 by posting a reply to the Facebook post or through a private message. Eight more contacted us directly via phone or email during the next two days. Through questioning these sources, we discovered 12 other rumors circulating on WhatsApp.

Table 1 presents the categorization of the 13 rumors (appendix 1 portrays the rumors), the first time they were circulated on WhatsApp, the earliest source reached and the topic. The categorization was made retrospectively. Following the verification process, nine (69%) out of the 13 rumors were found to be true.

Of the nine rumors disseminated during the first day (June 13, 2014), five identified the names of two of the kidnapped teenagers. This information was not publicly available and was under censorship due to a military gag order. Only on Saturday June 15, the IDF censor approved the names of the three kidnapped teenagers for publication (YNET., 2014).

Rumor 3 was traced through two different threads, three levels deep, to two sources who are both highly connected to the press - a journalist and a university Communications professor. While speaking with a journalist's relative, she said, "oops, I just saw that it was written 'not to publish'." A senior military correspondent of a leading newspaper confirmed that the IDF Spokesperson provided the information relayed in the rumor in a statement he delivered to the military correspondents, requesting them not to disseminate it any further. According to him, one of the participants in the meeting transcribed the IDF Spokesperson's statement and disseminated it.

Rumor 7 contained the names of two of the kidnapped teenagers requesting more information and included a phone number. As a phone number was part of the message, we did not need to trace its source. The owner of the number stated that he sent it after receiving a request from the General Security Services (GSS). According to the source, it was clear at 05:00 that they [the boys] were kidnapped, and he sent the message at 07:00. The source also mentioned that he was a classmate of the two kidnapped teenagers, and that during the first hours they did not know that a third

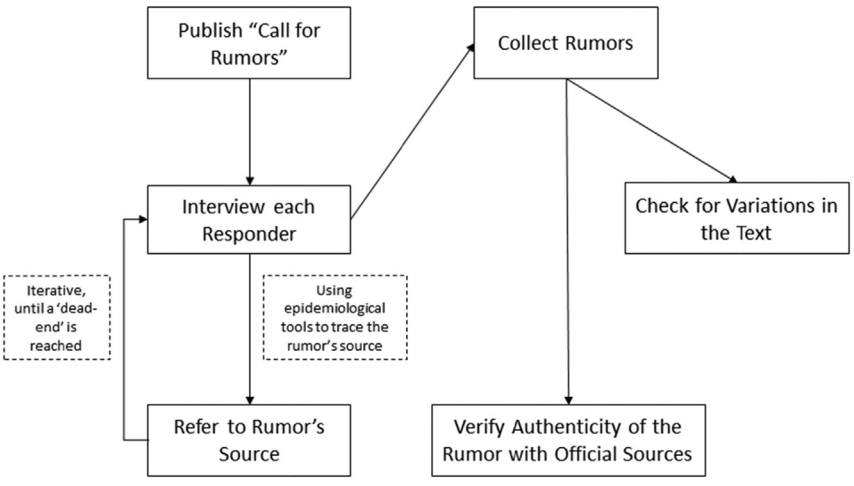

Fig. 1. A conceptual model of the research process aimed to collect rumors, trace their source and verify their content.

Table 1
The 13 collected rumors according to their source and status (verified as true or false). Security officials include IDF personnel as well as first responders. Family refers to the family members of the kidnapped teenagers.

		Rumor's # (appendix 1)	Verified as true	Verified as false	Cannot be confirmed	Total rumors
Source	Security officials	1, 8, 13	1	8	13	3
	NGOs	2	2			1
	Family	4	4			1
	Private citizens	5, 6, 7, 9, 10, 11	6, 7, 11	5, 9, 10		7
	Journalists	3	3			1

teenager was taken. The source mentioned that he had received numerous phone calls from people reproaching him for publishing this information, as they claimed it was incorrect/inaccurate. According to the source, the callers stated that upon reading his message they immediately searched YNET, Israel's largest news site, and because no information was published there they concluded that it was false. At 10:00, the source said he received a call from a person living in a nearby settlement, who reported that he had driven past the bus stop from where they were kidnapped and had seen the three teenagers. He recognized the third one, and due to this phone call, the security forces learned that three rather than two people were kidnapped.

Rumor 8 had the widest circulation, as it stated that the kidnapped teenagers were rescued. It included information that appeared credible and was worded as if officially released by the IDF Spokesperson. Of the initial 12 sources, seven distributed the rumor further. Two shared it only with one family member, two shared it with their WhatsApp family group, one shared it with an IDF officers' WhatsApp group, one first responder shared it verbally with his colleagues during his shift and one refused to answer the question. The other eight sources provided only the date and time they received the rumor. An in-depth investigation was conducted on the input provided by the 12 respondents, enabling four of the rumor threads to be traced, three levels of sources deep (Fig. 2). This graph presents the research method conducted in order to locate the sources and dissemination path, displaying one rumor as an example. The fourth level source could not be reached, but the sources stated that it originated from an IDF member.

Rumor 9 was received through two contacts; one was a senior official in the government who requested help in tracing the rumor. The IDF Home Front Command (HFC) posted on their Facebook page that rumor 9 was incorrect and was not published by them (HFC 2014).

Rumor 10 was initially received through two contacts, but continued to propagate on WhatsApp until the afternoon of July 1, 2014, one day after the discovery of the three bodies.

Rumor 13 that pertained to the physical status of the bodies was received through a colleague whose brother was an IDF soldier involved in the search and rescue operations. Officials from the Ministry of Public Security and the Ministry of Health declined to comment on it.

Fig. 3 presents the timeline of the rumors disseminated during the event. The information was collected during the event, commencing immediately after the kidnapping on June 13, continuing until the bodies were found on July 1.

In order to learn how the public uses social media, especially Facebook and WhatsApp, we distributed a web-based survey. The final sample included 419 respondents who fully completed the survey (among 471 who began to respond to the questionnaire). Among the respondents, 57% were female and 43% male. 92% and 72% use WhatsApp and Facebook respectively to send and receive messages, and 85% use WhatsApp rather than Facebook to keep in touch with their families. WhatsApp is used more frequently than Facebook ($Z = -9.37$, $p < 0.001$): 46.5% reported they use the

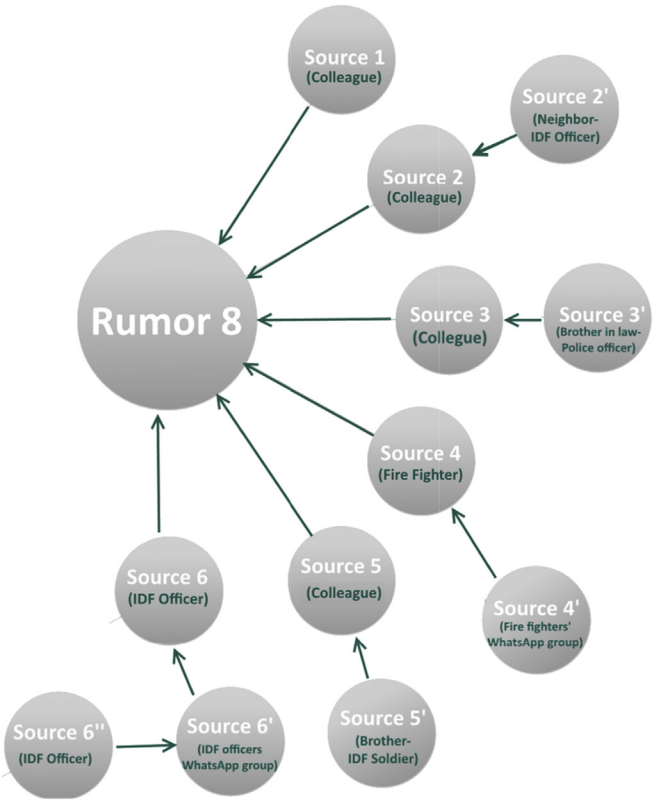

Fig. 2. The sources of rumor #8 (appendix 1), their affiliation and dissemination path.

application hourly, while 19% reported the same for Facebook. A total of 40.4% stated that they received the (false) rumor regarding the successful rescue operation of the kidnapped boys a day after it occurred, through WhatsApp. Among those who received it, 21.9% stated they forwarded it to others. 46% reported that they received it through a WhatsApp group, 8.4% through a colleague, 23.7% through a friend, and 21.7% through a family member. Only 34% stated that they did not receive any information regarding the kidnapping through social media. Of those who received updates, 61.1% received them through WhatsApp and 38.9% through Facebook.

The respondents perceived WhatsApp to be significantly more private than Facebook ($Z = 14.67$, $p < 0.001$) while Facebook's credibility was perceived as significantly higher ($Z = 3.74$, $p < 0.001$) than that of WhatsApp messages (35% rated Facebook credibility as reasonable vs. 23.5% for WhatsApp).

4. Discussion

The process of collecting the 13 rumors was sometimes difficult, especially following the news that the police were also looking into this subject. Kwon et al. (2013) noted that the study of rumor

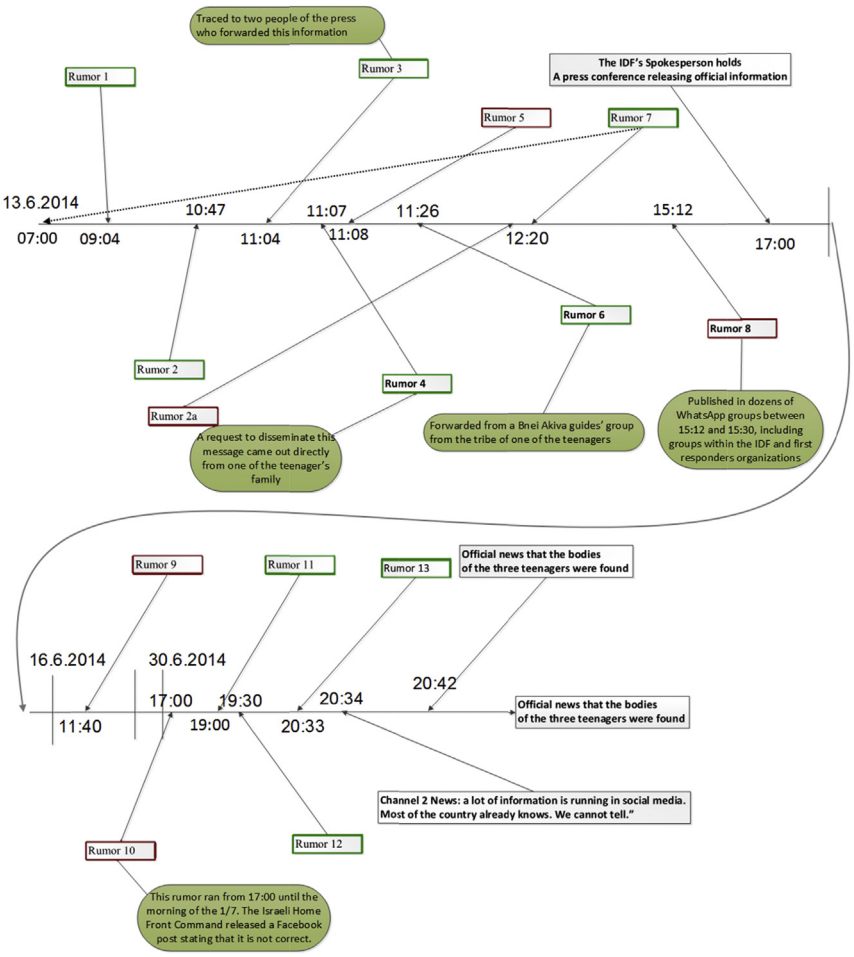

Fig. 3. The full timeline showing the rumors and date and time of the earliest source found. Green frame represents a verified rumor, and a red frame represents an unverified rumor. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

propagation is complex because "one must be at the right place at the right time." Scanlon described the collection process as work executed by a detective (Scanlon 1977), but in this case, the authors did not have the police's authority for investigation and questioning. Thus, cooperation from the initial sources was based on trust and assurances not to disclose their involvement. Several respondents expressed their willingness to contribute, which is consistent with previous research that showed that during emergencies, people want to act and contribute (Sutton, Palen and Shklovski 2008; Wolensky, 1979). Another factor that made the collection process more difficult was the inherent difference between the sharing mechanisms of Twitter and Facebook vs. WhatsApp. Whereas the identity of the originator is known and visible while sharing on Twitter (retweet) or Facebook, there is no way to know the source of messages shared on WhatsApp.

The results indicate that rumors and information originated from the family and close community of the three teenagers. One example is the prayer request for their wellbeing, which was disseminated within their religious community, who were already aware of their disappearance. The WhatsApp message included specific information and the names of two of the teenagers. This information was not known at the time, which might explain their distribution to much larger circles, beyond the community's virtual boundaries. Previous research has shown that during emergencies people leverage information technologies to "find community" and to use it to assist one another (Shklovski, Palen and Sutton 2008). A more recent study found that WhatsApp enhances a "sense of belonging" to a community and "sense of connection" with various groups (Church & Oliveira, 2013).

The government issued a very strict gag order on the kidnapping and the military search operation, even including a clause prohibiting publication of the existence of the gag order (Horowitz, Roth and Weiss 2014). This caused a 'severe' lack of information for the public, as no official information could be released. During the morning and early afternoon of the day after the abduction (June 14), eight rumors/stories circulated on WhatsApp, until the IDF Spokesperson released a few details concerning the incident during his first press conference. The gag order, coupled with incomplete information circulating through WhatsApp, increased people's efforts to find information. This behavior is consistent with that found in previous research. Mileti and Darlington (1997) showed that during periods of intense stress, people use whatever means available to obtain information. This is especially evident during terror events in which the main goal is to create "feelings of anxiety and fear among its targets" (Ben-Yehuda, 2005). Nonetheless, the gag order was only presented to traditional news outlets. The general population did not know about its existence and thus continued to share information on social media, especially through WhatsApp. This study shows that the traditional gag order does not affect social media, and cannot control or inhibit the flow of information through the sources.

Similar to recent terror events (Simon, Goldberg, Aharonson-

Daniel, Leykin, & Adini, 2014), the initial news and information about the kidnapping were initially disseminated to the public through social media.

The public used WhatsApp throughout the entire event as a priority channel to communicate and share information. These findings indicate that the public perceives WhatsApp to be significantly more private than Facebook. It seems that during a sensitive security event, WhatsApp (in comparison to other communication channels) is perceived by the public as a safer, more private conduit to discuss and share rumors, without the risk of being exposed to the police (risk of legal prosecution) or to unwanted eyes (risk of leaking confidential information). During emergencies and times of high stress, when information is lacking, people will try to obtain information using backchannels, such as social media (Sutton, Palen and Shklovski 2008). Although the gag order was probably issued because the authorities were concerned about the teenagers' wellbeing, many of the rumors can be defined as news updates regarding the military operation and its outcomes, providing an alternative to the lack of official reports. During the last few years, the public has used social media to report news regarding terror attacks worldwide, as well as acted as civilian journalists (Burnap et al. 2014;; Laituri & Kodrich, 2008).

In Israel, journalists covering military and defense issues receive updates from the IDF Spokesperson, even though a gag order is in place. On the morning of June 14, the IDF Spokesperson conducted an internal briefing with all journalists covering the military operation and provided exclusive information about the incident. These updates are based on trust and a long-standing relationship between journalists and the IDF Spokesperson. Through two rumor chains we found that two journalists leaked information from this confidential briefing to their families through WhatsApp. Lee (2007) mentioned in his paper that, "reporters covering national security issues observe that sensitive topics involving classified information can only be confirmed and placed into context through confidential sources." In our case, the journalists received classified information directly and officially from the IDF, based on trust and the knowledge that the information is protected by a court-issued gag order. The two journalists informed their close circle only through WhatsApp, probably perceiving it to be a private channel, but by doing so, breached their trust with the IDF. Bierbauer (2011) mentions that although journalists want to publish and expose information, "most are inclined to accept the necessity for some degree of secrecy", especially when granted official access to sensitive military information. Future research should address this issue, and strive to interview journalists after a confidential military briefing, in order to identify how many of them shared classified information.

During this event we found that emergency authorities, including first responders, shared and forwarded rumors to others. Two sources stated that they either shared the rumors with their colleagues or received it through their organization's official WhatsApp group. Both organizations have a solid presence on Facebook, and during emergencies they share relevant information with the public. This finding is inconsistent with previous literature. According to a report published by the US Department of Justice, first responders should dispel rumors and provide accurate information about the event (Chapman et al. 2002). When emergency authorities and first responders, even in an unofficial capacity, share unconfirmed information during emergencies, the information is perceived to be more credible than information spread by regular citizens. Wray et al. (2008) noted that during emergencies, the public perceives first responders as more credible as they are perceived to hold valid information. This process may create rumor amplification and disseminate the rumor faster and to even larger crowds. The public does not understand that first responders do not necessarily know everything about an ongoing emergency, especially during a terror event in which information may be highly compartmentalized, even among security forces. Similar to citizens, first responders also strive to obtain information by every possible means. Furthermore, this finding extends the concept of 'backchannels' used by emergency authorities to circumvent communication gaps and prohibitions against disseminating information (Sutton, Palen & Shklovski, (2008).

During the entire operation, official representatives did not correct or refute any of the rumors. The three main TV channels continuously broadcasted commentary from many former officials and military generals. This caused many people to stay tuned to their TVs in the hope that new information would be released. Research shows that during emergency events, individuals are exposed to large quantities of information without knowing the validity or risk of misinformation (Lu & Yang, 2010). One of the first actions people take is to try to validate the information through other and/or official sources (Glik, 2007). In this case, no other sources of reliable information were available, so the public relied on the information disseminated through social media, especially WhatsApp. However, during the early morning of June 13, 2014, people who received one or more of the rumors, as in the case of rumor 7, could not find any validating information on news sites, so they did not believe the content.

This finding is in contrast to other studies that found that mass social media self-regulates in emergencies, as people question information they do not trust or validate correct information (Mendoza, Poblete and Castillo 2010; Heverin & Zach, 2012; Starbird et al. 2014). Future research should examine whether the rumors spread on social media during terror events are different than those propagated during other types of emergencies.

Locating the source of a rumor, even in real time, is almost impossible. Various studies proposed an epidemiological investigation to find the 'patient zero', using the rationale that the spread of an infection is similar to the propagation of rumors (Cane, 1966). Others, using a computerized model knew the source of the rumor all along, and during the propagation process each 'member' was aware of the original source (Haeupler, 2013). A number of papers reported that the researchers assumed to know who originated the rumor, and the exact path of the rumor through a defined network (Calves) (Borge-Holthoefer, Meloni, Gon¸calves, & Moreno, 2013;; Haeupler, 2013). Similar to the epidemiological public health methodology, the current study used 'manual' methods to collect and track the path of the rumors. The adoption of this approach is unique, as most work in the field of social media research is conducted using automated, computerized methods. The problem with using computerized models to track rumor propagation is that they rely on monotonic 'human' behavior (Zhang, Zhou, Zhang, Guan, & Zhou, 2013), or on a deterministic model, which offers an algorithm for tracking the dissemination of rumors more efficiently and in "optimal running time" (Haeupler, 2013). While these methods offer novel research approaches, they do not necessarily predict actual human behavior.

4.1. Limitations

Snowball sampling has two limitations that should be mentioned. The first is that it may impact on the generalizability of the paper as there might be a bias towards the initial list of sources (seed list). Although the seed list may have been biased, the chain effect of this technique allowed us to reach the deeper and hidden sources, otherwise unreachable, of the rumors. A significant advantage of leveraging the snowball sampling, for this research, was the trust existing between the sources during the referral process, resolving the issue of people who do not want to be

located. The second limitation is the inability of snowball sampling to reach disjoint groups. However, this paper presented that the second limitation may be less significant while dealing with social media. The sources reached during the research process are distinctly disjoint from the community and social milieu of the authors emphasizing the strength of this method for social media research. Despite the limited sample size we believe that the overall scope of the study, in which all of the identified rumors that circulated during the duration of the rescue operation were identified and traced, compensates for this limitation and enables to draw conclusions that shed a light on rumor propagation through social media in emergencies. We believe that the comprehensive tracing, verification and validation process enabled to identify all rumors that were disseminated throughout the event; this process included both a call for the general public as well as a direct approach to Ministerial authorities such as the Ministry of Internal Security - responsible for all first responders and Ministry of Health, security agencies first responders organizations, as well as civilian authorities.

Another limitation materialized a few days after the research began when the Israeli Police started its own investigation into these rumors and their sources. This introduced a difficulty in gaining the trust and cooperation of the sources in providing the required information as well as their sources. In order to mitigate it and alleviate the concerns of the sources, we provided extensive information and background during the introduction to the research and throughout the investigation process.

5. Conclusions

Rumors pose a real challenge for first responders and other authorities in emergencies. Rumors may create moral dilemmas and can affect the perception emergency responders attribute to their positions. Commanders and leaders of emergency organizations should have policies and guidelines in place to manage rumors propagating within their organizations during emergencies. These should include a direct way to notify the organization of the rumor, and to notify employees regarding their authenticity. Information originating from emergency authorities to the public is perceived as true and reliable.

Furthermore, this study has shown that it is very important to actively search for rumors during emergencies. For the collection process, it might be advisable to use personnel external to the emergency agencies, as people might be more reluctant to share the information and especially their sources with authority figures. This study, as well as others, showed that individuals, whether citizens or emergency responders, actively search for information during emergencies, especially when no official information is available. Within organizations, such behavior can be managed if information is provided in a "push" mode, where employees are notified proactively about circulating rumors and their authenticity (as much as possible). This can minimize rumor dissemination from within emergency organizations. Future research should focus on the behavior of first responders and other emergency personnel regarding rumors and information exchange with the public.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.chb.2016.06.058.

References

Abbasi, A., Hossain, L., Hamra, J., & Owen, C. (2010). Social networks perspective of firefighters' adaptive behaviour and coordination among them. In *ACM international conference on cyber, physical and social computing. Washington, DC* (pp. 819–824). ACM.

Ahern, K. R., & Sosyura, D. (2014). *Rumor has It: Sensationalism in financial media*. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2264468.

Ben-Yehuda, N. (2005). Terror, media, and moral boundaries. *International Journal of Comparative Sociology*, 33–53.

Bierbauer, C. (2011). When everything is classified, nothing is classified. *The Wake Forest Journal of Law & Policy*, 21–30.

Bird, D., Ling, M., & Haynes, K. (2012). Flooding facebook – The use of social media during the queensland and victorian floods. *The Australian Journal of Emergency Management, 27*(1), 27–33.

Borge-Holthoefer, J., Meloni, S., Gon¸calves, B., & Moreno, Y. (2013). Emergence of influential spreaders in modified rumor models. *Journal of Statistical Physics, 151*(1–2), 383–393.

Boyle, M. P., Schmierbach, M., Armstrong, C. L., McLeod, D. M., Shah, D. V., & Pan, Z. (2004). Information seeking and emotional reactions to the september 11 terrorist attacks. *Journalism & Mass Communication Quarterly*, 155–167.

Burnap, P., Williams, M. L., Sloan, L., Rana, O., Housley, W., Edwards, A., et al. (2014). Tweeting the terror: Modelling the social media reaction to the woolwich terrorist attack. *Social Network Analysis and Mining*, 1–14.

Cane, V. R. (1966). A note on the size of epidemics and the number of people hearing a rumour. *Journal of the Royal Statistical Society, 28*(3), 487–490.

Cassa, C. A., Chunara, R., Mandl, K., & Brownstein, J. S. (2013). Twitter as a sentinel in emergency Situations: Lessons from the Boston Marathon explosions. *PLOS Currents Disasters*. http://dx.doi.org/10.1371/currents.dis.ad70cd1c8bc585e9470046cde334ee4b. Edition 1.

Chapman, R., Baker, S., Bezdikian, V., Cammarata, P., Cohen, D., Leach, N., et al. (2002). *Local law enforcement responds to terrorism - Lessons in prevention and preparedness*. Washington D.C: U.S: Department of Justice - Office of Community Oriented Policing Services.

Church, K., & Oliveira, R. de (2013). What's up with WhatsApp? comparing mobile instant messaging behaviors with traditional SMS. In *Proceedings of the 15th international conference on Human-computer interaction with mobile devices and services* (pp. 352–361). ACM.

Dervin, B. (1983). An overview of sense-making: Concepts, methods, and results to date. In *The annual meeting of the international communications association. Dallas, Texas*.

Dvorin, T. (2014). *IDF bans soldiers from using WhatsApp for operations*. Arutz Sheva - Israel National News. February 26. [Accessed June 28.06.14] http://www.israelnationalnews.com/News/News.aspx/177903#.U66mkpSSxu4.

G, Sravan Kumar (2013). Ranking assessment of event tweets for credibility. *International Journal of Scientific Engineering and Research, 1*(2).

Glik, D. C. (2007). Risk communication for public health emergencies. *The Annual Review of Public Health*, 33–54.

Gupta, A., Lamba, H., Kumaraguru, P., & Joshi, A. (2013). Faking Sandy: Characterizing and identifying fake images on twitter during hurricane Sandy. In *22nd international conference on World Wide Web companion. Rio de Janeiro* (pp. 729–736). Brazil: ACM.

Haeupler, B. (2013). Simple, fast and deterministic gossip and rumor spreading. In *Proceedings of the twenty-fourth annual ACM-SIAM symposium on discrete algorithms* (pp. 705–716). ACM.

Hagar, C. (2013). Crisis Informatics: Perspectives of trust – Is social media a mixed blessing? *Student Research Journal, 2*(2).

Heverin, T., & Zach, L. (2012). Use of microblogging for collective sense-making during violent crises: A study of three campus shootings. *Journal of the American Society for Information Science and Technology, 63*, 34–47.

HFC. 2014. July 1. https://www.facebook.com/pikudhaoref/posts/750528064990921.

Horowitz, A., Roth, S., & Weiss, P. (2014). *Israel maintains gag order in missing teens' case, leading to charge of media 'manipulation'. June 23*. http://mondoweiss.net/2014/06/maintains-missing-manipulation.

Starbird, Kate, Jim, Maddock, Mania, Orand, Peg, Achterman, & Robert M., Mason (2014). "Rumors, false flags, and digital Vigilantes: Misinformation on twitter after the 2013 Boston Marathon bombing. In *iConference 2014 Proceedings* (pp. 654–662).

Koum, J., & Zuckerberg, M. (2015). *Facebook. September 4* Accessed January 16.01.16] https://www.facebook.com/jan.koum/posts/10153580960970011.

Kwon, S., Cha, M., Jung, K., Chen, W., & Wang, Y. (2013). Aspects of rumor spreading on a microblog network. *Social Informatics*, 299–308.

Laituri, M., & Kodrich, K. (2008). On line disaster response community: People as sensors of high magnitude disasters using Internet GIS. *Sensors*, 3037–3055.

Lapin, Y. (2014). *Bodies of three kidnapped Israeli teens found in West Bank. June 30*. http://www.jpost.com/Operation-Brothers-Keeper/Large-number-of-IDF-forces-gather-north-of-Hebron-in-search-for-kidnapped-teens-361048.

Lee, W. E. (2007). Deep Background: Journalists, sources, and the perils of leaking. *American University Law Review, 57*(5), 1453–1529.

Lu, Y., & Yang, D. (2010). Information exchange in virtual communities under extreme disaster conditions. *Decision Support Systems*, 529–538.

Ma, R. (2008). Spread of SARS and war-related rumors through new media in China. *Communication Quarterly*, 376–391.

Mendoza, M., Poblete, B., & Castillo, C. (2010). Twitter under Crisis: Can we trust what we RT?. In *Proceedings of the first workshop on social media analytics* (pp. 71–79). Washington, DC: ACM.

Mileti, D. S., & Darlington, J. D. (1997). The role of searching in shaping reactions to earthquake risk information. *Social Problems*, 89–103.

Palen, L., & Liu, S. B. (2007). Citizen communications in Crisis: Anticipating a future of ICT-supported public participation. In *Proceedings of the SIGCHI conference on Human factors in computing systems. San Jose, CA* (pp. 727–736).

Rosnow, R. L., John, H. Yost, & Esposito, J. L. (1986). Belief in rumor and likelihood of rumor transmission. *Language & Communication, 6*(3), 189–194.

Scanlon, T. Joseph (1977). Post-Disaster rumor chains: A case study. *Mass Emergencies, 2*, 121–126.

Shklovski, I., Palen, L., & Sutton, J. (2008). Finding community through information and communication technology in disaster response. In *Proceedings of the 2008 ACM conference on computer supported cooperative work. New York: Association for computing machinery* (pp. 127–136).

Simon, T., Goldberg, A., Aharonson-Daniel, L., Leykin, D., & Adini, B. (2014). Twitter in the cross Fire—The use of social media in the westgate mall terror attack in Kenya. *PloS one, 9*(8).

I. D. F. Spokesperson. (2015). *IDF 2014 yearly summary. January.* https://www.idfblog.com/IDFsummary2014/.

Lewandowsky, Stephan, Werner, G. K. Stritzke, Alexandra, M. Freund, Klaus, Oberauer, & Joachim, I. Krueger (2013). Misinformation, disinformation, and violent conflict – From Iraq and the "war on terror" to future threats to peace. *American Psychologist, 68*(7), 487–501.

Stiegler, R., Tilley, S., & Parveen, T. (2011). Finding family and friends in the aftermath of a disaster using federated queries on social networks and websites. In *Web systems evolution (WSE), 2011 13th IEEE international symposium on. Melbourne, FL* (pp. 21–26). IEEE.

Sutton, J., Palen, L., & Shklovski, I. (2008). "Backchannels on the front lines: Emergent use of social media in the 2007 Southern California fire. In *Proceedings of the 5th international ISCRAM conference. Washington, DC, USA*.

The Marker. (2014). *Nice soviet jewish boys making it big in silicon valley. Ha'aretz. February 20* Accessed June 28.06.14 http://www.haaretz.com/business/.premium-1.575317.

WhatsApp. (2014). *WhatsApp blog - 500,000,000. WhatsApp. April 22* Accessed June 28.06.14 https://blog.whatsapp.com/613/500000000.

Wolensky, R. P. (1979). Toward a broader conceptualization of volunteerism in disaster. *Journal of Voluntary Action Research*, 33–42.

Wray, R. J., Becker, S. M., Henderson, N., Glik, D., Jupka, K., Middleton, S., et al. (2008). Communicating with the public about emerging health threats: Lessons from the pre-event message development project. *American Journal of Public Health*, 2214–2222.

YNET.. (2014). *Timline of terror: From abduction to murder. July 1.* http://www.ynetnews.com/articles/0, 7340,L-4536520,00.html.

Zhang, Y., Zhou, S., Zhang, Z., Guan, J., & Zhou, S. (2013). Rumor evolution in social networks. *Physical Review E, 87*(3).